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# Intra- and Interindividual Variability in the Behavioral, Affective, and Perceptual Effects of Alcohol Consumption in a Social Context

Minita Franzen , Gentiana Sadikaj , Debbie. S. Moskowitz, Brian D. Ostafin, and Marije aan het Rot

**Background:** We examined the influence of interindividual differences in alcohol use on the intraindividual associations of drinking occurrence with interpersonal behaviors, affect, and perceptions of others during naturally occurring social interactions.

**Methods:** For 14 consecutive days, 219 psychology freshmen (55% female;  $M_{\text{age}} = 20.7$  years,  $SD = 2.18$ ) recorded their behaviors, affect, and perceptions in social interactions soon after an interpersonal event occurred. Interpersonal behaviors and perceptions were assessed in terms of dominance–submissiveness and agreeableness–quarrelsomeness. Participants also reported the number of alcoholic drinks consumed within 3 hours of each interaction. We considered the intraindividual associations of (i) having a drinking episode and (ii) the number of drinks during an episode with behaviors, affect, and perceptions and examined interindividual differences in drinking frequency and intensity during social interactions as potential moderators of these associations.

**Results:** Social drinking frequency and intensity moderated the associations between drinking episode and behaviors, affect, and perceptions in social interactions. During a drinking episode, more frequent social drinkers perceived others as more dominant than less frequent social drinkers. During a drinking episode in which more alcohol was consumed than usual, more frequent social drinkers also reported behaving more dominantly and experiencing less pleasant affect.

**Conclusions:** As more frequent social drinkers had different interpersonal responses to drinking than less frequent social drinkers, including when they had consumed larger amounts of alcohol than usual, our results suggest a differential susceptibility to the effects of alcohol during naturally occurring social interactions among drinkers with varying drinking frequency.

**Key Words:** Alcohol, Social Interaction, Event-Contingent Recording, Interpersonal Functioning.

ALCOHOL IS COMMONLY used in today's society (Naimi et al., 2013), and college students are frequent users (Substance Abuse and Mental Health Services Administration, 2015). Alcohol use is widespread despite growing knowledge about the possible devastating effects of alcohol on people's health such as liver cirrhosis, cancers, and injuries (World Health Organization, 2014). Positive associations of drinking with alcohol outcome expectancies have been proposed as possible reasons for why individuals still engage

in drinking. Studies with college students have found that holding positive associations about drinking (e.g., I would feel calm and I would be friendly) were associated with alcohol use in the past, present, and future (Ham et al., 2013; Nicolai et al., 2010; Zamboanga et al., 2006).

Some of these positive expectancies have been empirically confirmed. Alcohol intake has been associated with better mood (aan het Rot et al., 2008; Doty and de Wit, 1995; Treloar et al., 2015), more friendly and agreeable behaviors, respectively (aan het Rot et al., 2008; Doty and de Wit, 1995), more agreeable perceptions of others (aan het Rot et al., 2008), and better social skills (Knight and Godfrey, 1993). Associations have also been found between consuming alcohol and fewer quarrelsome behaviors (aan het Rot et al., 2008), less state social anxiety (Battista et al., 2015), and lower negative mood (aan het Rot et al., 2008; Treloar et al., 2015), indicating that alcohol consumption can promote pleasant affect, social behavior, and social perceptions.

Drinking can lead to undesirable and disruptive outcomes. Alcohol consumption has been found to be related to verbal and physical aggression as well as violence (Maldonado-Molina et al., 2010; Murdoch et al., 1990; Sharma and Marimuthu, 2014) and a decrease in friendliness (Childs et al., 2011). Particularly intense drinking episodes (i.e., with 5 or

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more drinks per drinking occasion) have been associated with sexual assault and attempted sexual assault (Buddie and Testa, 2005), risky sexual behavior, and a higher rate of injuries (Bradley et al., 2001).

Thus, alcohol can trigger both desirable and undesirable outcomes. Moreover, individuals vary widely in their response to alcohol (Ray et al., 2009). Heterogeneous effects of alcohol can be observed within the person; for example, when drinking, an individual might experience more or less pleasurable effects. Between-person differences also might influence these effects such that when drinking, some individuals might be more likely to experience more desirable outcomes than others.

Within-person or intraindividual differences in reactivity to alcohol have been explained by an interaction between alcohol-induced myopia and situational cues. According to Steele and Josephs (1990), alcohol can induce less inhibited, more impulsive behavioral responses. However, whether a person acts upon spontaneous impulses depends on situational cues that promote or impede excessive positive and negative behaviors (Steele and Josephs, 1990). Hence, there seems to be complex person by situation influences that might trigger a wide range of behavioral and affective responses under the influence of alcohol.

Intraindividual differences in the effect of alcohol have also been explained by biphasic subjective responses to alcohol (Earleywine, 1994; Earleywine and Martin, 1993). When blood alcohol levels are rising (i.e., the ascending limb of intoxication), alcohol triggers stimulatory and hedonic subjective effects. When these blood levels are decreasing (i.e., the descending limb of intoxication), individuals report largely sedative and unpleasant effects (Erblich et al., 2003; Ray et al., 2009; Roche et al., 2014). These biphasic subjective responses to alcohol are influenced by the amount of alcohol consumed. In general, it has been shown that the likelihood of experiencing negative effects with drinking increases with the amount consumed (Gruenewald and Mair, 2015). These results imply intraindividual dose-dependent variability in experiencing pleasant and unpleasant effects of alcohol.

This intraindividual variability in biphasic subjective responses and dose responses is moderated by interindividual drinking characteristics. Intense drinkers (i.e., who consume more drinks on average than others) or frequent drinkers (i.e., with more drinking episodes than others) experience greater pleasant effects and fewer unpleasant effects after drinking than light drinkers or less frequent drinkers, respectively (King et al., 2011; Quinn and Fromme, 2011). Similar findings have been reported for drinking dose; intense drinkers report fewer negative effects for each additional drink compared to light and moderate drinkers (Gruenewald and Mair, 2015). Thus, when assessing the outcomes of drinking, the possible moderating qualities of interindividual variability in drinking amount and frequency on intraindividual effects should be taken into account. In sum, drinking and associated alcohol-related problems should be examined

from intra- and interindividual perspectives to aid the understanding of the effects of alcohol (Simons et al., 2014).

Research so far has mainly focused on assessing the effects of alcohol in laboratory settings primarily using challenge designs, in which participants receive varying amounts of alcohol or a placebo beverage (Morean and Corbin, 2010). Few studies have taken place in real life. One study assessing the effects of alcohol in naturalistic settings (aan het Rot et al., 2008) found higher levels of positive affect and agreeableness when people were drinking and found that participants perceived others as more agreeable when drinking. Further, drinking was sometimes associated with lower levels of quarrelsomeness, and there was no evidence that drinking made people more quarrelsome or induced aggression. The conclusion was that social drinking had prosocial effects. aan het Rot and colleagues (2008) only examined intraindividual variability and did not examine interindividual variability in the effect of alcohol which, as previously indicated, may contribute to identifying intraindividual patterns in the effects of drinking.

The present study can be understood as an extension of aan het Rot and colleagues (2008) with a different sample. We assessed intraindividual variability in the association of alcohol with interpersonal affect, behavior, and perception of others using an event-contingent recording (ECR) method to collect data for a period of 14 days. The current study also examined the influence of interindividual differences in episodes and in the amount of drinking on affect, behavior, and perceptions of others. Furthermore, we examined potential moderating effects of interindividual differences in drinking frequency and amount during social interactions on intraindividual effects of alcohol.

Based on aan het Rot and colleagues (2008), we expected that when people drank, they would experience more positive affect and agreeableness, less quarrelsomeness, and perceive others as more agreeable. Based on King and colleagues (2011), who found that intense (i.e., consuming large amounts) and frequent drinkers experienced greater stimulating and hedonic effects after drinking, we expected that when more intense and more frequent social drinkers in our sample drank, they would report more pleasant affect, more agreeable behavior and possibly perceive others as more agreeable than less intense and less frequent social drinkers. As alcohol has been shown to disinhibit behavior (Steele and Josephs, 1990), and disinhibition of behavior leads to more power-oriented behaviors (Keltner et al., 2003), we expected more frequent and intense drinkers to engage in more dominant behaviors.

## MATERIALS AND METHODS

The analysis is based on data from 3 studies which are analogous with regard to their procedures. For the sake of simplicity, Studies 1 and 2 are described in detail. Differences in the procedure of Study 3 are mentioned explicitly; otherwise the description of the methods can be applied to all 3 studies.

### Participants

The Ethics Committee of the Department of Psychology at the University of Groningen approved each study and confirmed that the study procedures were consistent with the Declaration of Helsinki.

First-year students in the English (Studies 1 to 3)- and Dutch (Study 3 only)-language Bachelor of Psychology programs at the University of Groningen were recruited via a website exclusively accessible to this cohort. There were no other selection criteria. Participants received study credits once they had completed the study.

Participants who failed to report 4 or more days of social interactions ( $n = 24$ ), thereby providing data on less than 70% of the time period of participation, or who decided to exercise their right to stop participating ( $n = 8$ ), were excluded from further analyses. An overview of sample characteristics is shown in Table 1.

To be eligible to participate in Study 3, it was obligatory for students to own a smartphone.

### Measures

**Event-Contingent Recording.** We applied the ECR method (Moskowitz et al., 2009) to sample everyday life social interactions. In this form of ecological momentary assessment, interpersonal behaviors and perceptions can be assessed in specific events. A social interaction event was defined as a spoken conversation, either in person or on the phone (and video chat for Study 3), lasting at least 5 minutes. For 14 consecutive days, participants in all studies were instructed to complete a short form about the interaction close in time after an interaction had occurred. In Studies 1 and 2, ECR data were collected using paper records. Study 3 involved data collection using an application on participants' smartphones. A link to the online software TEMPEST (Batalas and Markopoulos, 2012) was installed on participants' smartphones for participants to report data about their social interactions. Data could be reported both online and offline.

**Affect.** Forms included a list of affect items (Diener and Emmons, 1984) asking participants how they felt during the interaction. Each item was rated on a scale ranging from 0 ("not at all") to 6 ("extremely"). To obtain an unpleasant affect score, the mean score on worried/anxious, frustrated, angry/hostile, unhappy, and depressed/blue was calculated. To generate a pleasant affect score, the mean score on happy, pleased, joyful, and enjoyment/fun was calculated.

**Table 1.** Descriptive Statistics for Participant Characteristics

	Study 1	Study 2	Study 3	Studies 1 to 3 combined
Initial <i>N</i>	74	66	48 (Dutch), 63 (English) 111 (Total)	251
<i>N</i> of exclusions (%)	4 (5.4)	3 (4.5)	25 (22.5)	32 (12.7)
Final <i>N</i> as used in analysis (% female)	70 (41)	63 (56)	86 (65)	219 (55)
Age range in years	18 to 34	18 to 27	18 to 25	18 to 34
Mean age in years (SD)	21.63 (2.9)	20.48 (1.5)	20.01 (1.5)	20.66 (2.2)
Nationality in % Dutch/ German/ Other	6/73/21	11/72/17	49/43/8	22/63/15

**Behavior.** Each form also included a list of behavioral items from the Social Behavior Inventory (SBI; Moskowitz, 1994), and participants were asked to report which behaviors they engaged in during the interaction by ticking the relevant items. The SBI represents behaviors related to quarrelsomeness, agreeableness, dominance, and submissiveness which constitute the poles of the interpersonal circumplex model described by Leary (1957). To shorten the time necessary for responding and to prevent participants from adopting a response set, each form included 1 of 4 subsets of questions of the SBI. Each form included 3 items representing quarrelsome (e.g., "I ignored the other[s] comments"), agreeable (e.g., "I smiled and laughed with the other[s]"), dominant (e.g., "I expressed an opinion"), and submissive (e.g., "I let others make plans or decisions") behaviors. Scores for each of the 4 behaviors were calculated for each record form by computing their individual mean frequency and then subtracting the mean frequency for all behaviors. These ipsatized scores reflect the frequency with which each kind of behavior was checked, adjusted for the participant's general rate of behavior checking.

**Perception.** Participants were asked to indicate their perception of the social interaction partner using an interpersonal grid (Moskowitz and Zuroff, 2005). On the horizontal axis, the grid was labeled Cold/Quarrelsome on the left side and Warm/Agreeable on the right side. The vertical axis was labeled Assured/Dominant on the top of the grid and Unassured/Submissive on the bottom of the grid. The grid consisted of a total of  $11 \times 11$  squares; participants could choose 1 of the 121 squares to indicate how the interaction partner behaved toward them during that specific interaction. The higher the score on the horizontal axis (i.e., the further right), the more warm and agreeable the interaction partner was perceived. The higher the score on the vertical axis, the more dominant and assured the interaction partner was perceived.

**Drinking.** Participants reported the number of alcoholic beverages that were consumed up to 3 hours prior to and including the reported interaction. One alcoholic beverage was defined as 1 glass of beer or wine, or 1 shot of hard liquor. Two variables were constructed to characterize the participant's intraindividual or event-level drinking. First, we created a dichotomous event-level variable (yes/no) that described whether the participant had drunk ( $1 \geq$  drinks) or had not drunk (0 drinks) in each social interaction event. The second event-level variable consisted of the number of alcoholic beverages that were consumed during a specific interaction and the previous 3 hours; number of drinks was found to range from 0 to 24.

We also created 2 interindividual or person-level drinking variables representing frequency and intensity of drinking during social interactions. One was calculated using the proportion of interactions that included alcohol out of all social interactions the participant had throughout the 14 days of the study; this person-level variable was used to describe the frequency of participants' social drinking behavior. The second person-level variable was created by dividing the total number of drinks consumed across drinking events by the number of interactions that included alcohol. Therefore, it described the average number of drinks that was consumed in a drinking event, referred to as the intensity of social drinking.

A social interaction in our study was defined as a conversation lasting at least 5 minutes, and we assessed number of drinks during the entire social interaction. Additionally, we asked participants to indicate the length of the interaction and entered that information as a covariate in our final models in order to avoid the length of the interaction (e.g., a 10-minute conversation vs. a 2-hour interaction) having a biasing effect on our analyses.

**Feedback Questionnaire on Compliance.** We assessed compliance with 3 questions. At the end of the ECR period, (i) participants were asked to indicate how accurately they recorded their interaction on a 6-point Likert scale ranging from 1 = "Not at all



accurately” to 6 = “Very accurately.” (ii) They were asked to estimate the percentage of interactions they reported immediately after they occurred (thus following instructions as opposed to backfilling at the end of a day); (iii) participants were asked to indicate the percentage of social interactions they failed to report.

### Procedures

All studies were advertised online (see Participants). Interested persons could sign up for a laboratory appointment, during which they read a study information sheet and discussed it with a research assistant. They were told that the purpose of the study was to gain insight into social interactions in real time. Afterward, participants provided written informed consent.

Participants in Studies 1 and 2 were given detailed instructions on the ECR forms and how and when to complete them. They received 14 envelopes each including 10 ECR forms and were instructed to complete as many ECR forms as possible per day with a maximum of 10. For further information, please refer to van der Rot and colleagues (2015). Within 1 week after completion of the ECR period, participants returned to the laboratory and completed a feedback questionnaire about their experience with the record forms. In Study 3, together with the assistance of the research assistant, participants installed the application on their personal smartphone. Next, they received detailed instructions on how and when to use the application on their smartphone to record their social interactions during the study. Finally, participants were asked to try filling in the application once, and questions about the procedure were answered by the research assistant. Within a week after the ECR period, participants completed the feedback questionnaire as in Studies 1 and 2.

### Data Analyses

The data for the 3 studies were merged and subsequently analyzed using multilevel modeling. Multilevel modeling is suitable for hierarchical data structures (i.e., events were nested within participants) in which observations are not independent. Analyses were performed using the procedure PROC MIXED in SAS (SAS version 9.4; SAS Institute, Cary, NC).

The dependent variables were affect, behaviors, and perception of others that were reported at each interpersonal event. Event-level alcohol occurrence and amount were level-1 predictors; and person-level frequency and intensity of social drinking were level-2 predictors. We first examined the main effects of event-level and between-person levels predictors on affect, behaviors, and perceptions of others. We then examined the cross-level interactions by entering the interaction terms between event-level drinking variables and between-person drinking variables. More specifically, we separately entered the interaction terms between the event-level dichotomous drinking variable with the between-person social drinking frequency variable and the event-level count drinking variable with the between-person social drinking intensity variable. As we merged

data of 3 studies, we controlled for study type to prevent possible effects of paper versus phone app technology.

Both event-level drinking variables, dichotomous (yes/no) drinking predictors and count drinking variable (number of drinks per occasion) were person-mean-centered. Specifically, person-level drinking variables were subtracted from each event-level drinking score. The new centered scores represent deviations from the person's average drinking.

The associations between the event-level drinking episode variable and the dependent variables represented the impact of a participant's drinking episode on the participant's dependent variable after adjusting for the participant's frequency of drinking episodes over the ECR period. In other words, the results of the effects of the dichotomous drinking variable on the dependent variables represented the effects of the participant's drinking episode relative to the person's average number of drinking episodes. To simplify the understanding of the effects of this person-mean-centered dichotomous drinking variable, we refer to it as “when a person had drunk.”

The associations between this count drinking variable and the dependent variables represented the effect of a participant's deviations in drinking amount from the participant's average drinking amount on the participant's dependent variables. We refer to this variable as “when a person had more drinks than usual.”

Both person-level drinking variables (i.e., social drinking frequency variable and social drinking intensity variable) were grand-mean-centered such that the sample means of the variable were subtracted from each person-level drinking score.

The associations between a participant's frequency of social drinking and the participant's average behavior, affect, and perceptions of others were conceptualized as representing the effects of an individual's frequency of drinking during social interactions on the dependent variables. Frequency of drinking was centered relative to the sample mean of social drinking frequency. We refer to this variable as “frequent drinker effects.”

The associations between a participant's mean amount of drinks or intensity of drinking during social interactions and the participant's average behavior, affect, and perception of others were conceptualized as representing the effect of an individual's intensity of social drinking on the dependent variables. Intensity of drinking was centered relative to the sample average. We refer to these as “intense drinker effects.”

Participants were instructed to report their social interactions as soon as they occurred. Based on the feedback questionnaire on compliance, we visually and statistically inspected descriptive statistics for the paper ECR version (Study 1 and Study 2 combined) and the app version (Study 3). Due to nonnormal distribution of the scores, we compared median scores of the paper version with the app version (see Table 2).

Effect sizes were computed with the procedure recommended by Rosenthal and Rosnow (1984), using the formula  $r = \sqrt{F/F + df}$ . Significance was set at an alpha of 0.05. Based on the

**Table 2.** Descriptive Statistics and Comparison of the Median for Compliance of Reporting Social Interactions

		Minimum	Maximum	Mean	SD	Median	Z-value	p-Value median comparison
1. Accuracy of recording social interactions (scale 0 to 6)	Paper	2	6	4.66	0.80	5		
	App	2	6	4.37	0.94	5	−1.59	0.111
2. Immediately reported social interactions (%)	Paper	10	100	58.79	21.03	60		
	App	5	95	61.98	21.62	70	0.87	0.384
3. Not reported social interactions (%)	Paper	0	75	22.79	16.24	20		
	App	0	75	24.64	17.33	20	0.72	0.468

Paper represents Study 1 and Study 2 that used paper to record social interactions; App represents Study 3 that used the smartphone application to record social interactions.

recommendations of Aiken and colleagues (1991), significant interactions were probed by estimating simple intercepts and slopes for between-person predictor scores that were  $\pm 1$  SD of the sample mean in each predictor.

## RESULTS

### *Descriptive Statistics*

Of 12,666 social interactions included in the analyses, participants reported 957 (7.55%) interactions in which they had drunk alcohol. Averaged across all social interactions and throughout the 14-day period of the study, participants reported an average of 4.36 social interactions with alcohol and 53.46 social interactions without alcohol. Per day, participants reported an average of 0.31 social interactions involving alcohol and 3.82 interactions without alcohol. Participants reported an average of 3.37 drinks per occasion ( $SD = 2.86$ ) and a median of 2.00. The number of drinks ranged from 1 to 24. In 83.49% of cases, 1 to 5 drinks were reported; 16.51% of interactions involved 6 or more drinks; this indicates a right-skewed distribution which may lead to skewed probability distributions and inflation of type 1 errors.

For a summary of the findings of all main effects and interaction effects, refer to Table 3.

### *Associations Between Drinking and Interpersonal Behavior*

**Event Level (Within-Person).** Drinking was significantly associated with quarrelsome behavior ( $b = 1.82$ ;  $r_{\text{effect size}} = 0.021$ ), agreeable behavior ( $b = 2.69$ ;  $r_{\text{effect size}} = 0.029$ ), dominant behavior ( $b = -2.30$ ;  $r_{\text{effect size}} = 0.025$ ), and submissive behavior ( $b = -2.58$ ;  $r_{\text{effect size}} = 0.019$ ). When persons had drunk, they reported more quarrelsome and agreeable behavior, and less dominant and submissive behavior.

Number of drinks was significantly associated with quarrelsome behavior ( $b = 0.51$ ;  $r_{\text{effect size}} = 0.023$ ), agreeable behavior ( $b = 0.57$ ;  $r_{\text{effect size}} = 0.024$ ), dominant behavior ( $b = -0.53$ ;  $r_{\text{effect size}} = 0.022$ ), and submissive behavior ( $b = -0.40$ ;  $r_{\text{effect size}} = 0.021$ ). When persons had more drinks than usual, they also reported more quarrelsome and agreeable behavior and less dominant and submissive behavior.

**Person Level (Between-Person).** There was a significant association of social drinking frequency with quarrelsome behavior ( $b = 0.14$ ;  $r_{\text{effect size}} = 0.198$ ). Frequent social drinkers reported more quarrelsome behaviors across all reported events. No significant effects were found for frequency of social drinking on agreeable behavior, dominant behavior, or submissive behavior.

Significant effects were not found for intensity of social drinking (average number of drinks in drinking events) with respect to any of the behaviors measured, that is, quarrelsome behavior, agreeable behavior, dominant behavior, and submissive behavior.

**Table 3.** Associations Between Event-Level and Person-Level Drinking Variables and Interpersonal Behaviors, Affect, and Perceptions and Interaction Effects of Event-Level and Person-Level Drinking Variables on Interpersonal Behaviors, Affect, and Perceptions

	Event-level variables			Person-level variables			Drinking*Drinking frequency		Number of drinks*Drinking intensity	
	Drinking		Number of drinks	Drinking frequency		Drinking intensity	Drinking frequency		Drinking intensity	
	F	p		F	p		F	p	F	p
Quarrelsome behavior	5.91	0.015*	7.15	0.008*	8.89	0.003*	3.54	0.061	0.48	0.491
Agreeable behavior	10.83	0.001*	7.23	0.007*	0.51	0.475	0.03	0.852	0.76	0.383
Dominant behavior	8.17	0.004*	8.17	0.004*	3.36	0.068	0.39	0.531	4.52	0.034*
Submissive behavior	9.18	0.003*	5.73	0.017*	0.51	0.474	1.72	0.191	0.06	0.812
Positive affect	120.32	<0.0001*	95.94	<0.0001*	3.50	0.063	2.59	0.109	9.93	0.002*
Negative affect	6.01	0.014*	3.35	0.067	0.28	0.595	2.4	0.123	2.01	0.156
Perception of agreeableness	6.08	0.014*	11.32	0.0008*	4.17	0.042*	0.02	0.885	0.65	0.419
Perception of dominance	0.01	0.915	0.06	0.810	0.19	0.661	0.91	0.341	0.00	0.952

\* $p < 0.05$ .

*Effects of Person-Level Variables on Associations Between Event-Level Variables.* The frequency and intensity of social drinking did not significantly moderate the event-level associations between drinking episode and number of drinks and quarrelsome behavior, agreeable behavior, or submissive behavior. In addition, social drinking frequency did not significantly moderate the event-level association between drinking episode and dominant behavior. There was a significant effect for the interaction between number of drinks and intensity of social drinking on dominant behavior ( $b = 0.19$ ;  $r_{\text{effect size}} = 0.019$ ), such that the association between number of drinks and dominant behavior was stronger among individuals who were less intense social drinkers,  $b = -1.2886$ ,  $t(12E3) = -2.84$ ,  $p = 0.005$ , relative to more intense social drinkers,  $b = -0.486$ ,  $t(12E3) = -2.78$ ,  $p = 0.006$  (see Fig. 1). In other words, having more drinks than usual was associated with greater decreases in dominant behavior among less intense social drinkers than more intense social drinkers.

#### *Associations Between Drinking and Interpersonal Affect*

*Event Level (Within-Person).* There was a significant association of drinking on positive affect ( $b = 0.57$ ;  $r_{\text{effect size}} = 0.097$ ) and negative affect ( $b = -0.08$ ;  $r_{\text{effect size}} = 0.021$ ). Persons who had drunk reported experiencing more positive affect and less negative affect.

Number of drinks was significantly associated with positive affect ( $b = 0.14$ ;  $r_{\text{effect size}} = 0.087$ ) but not with negative

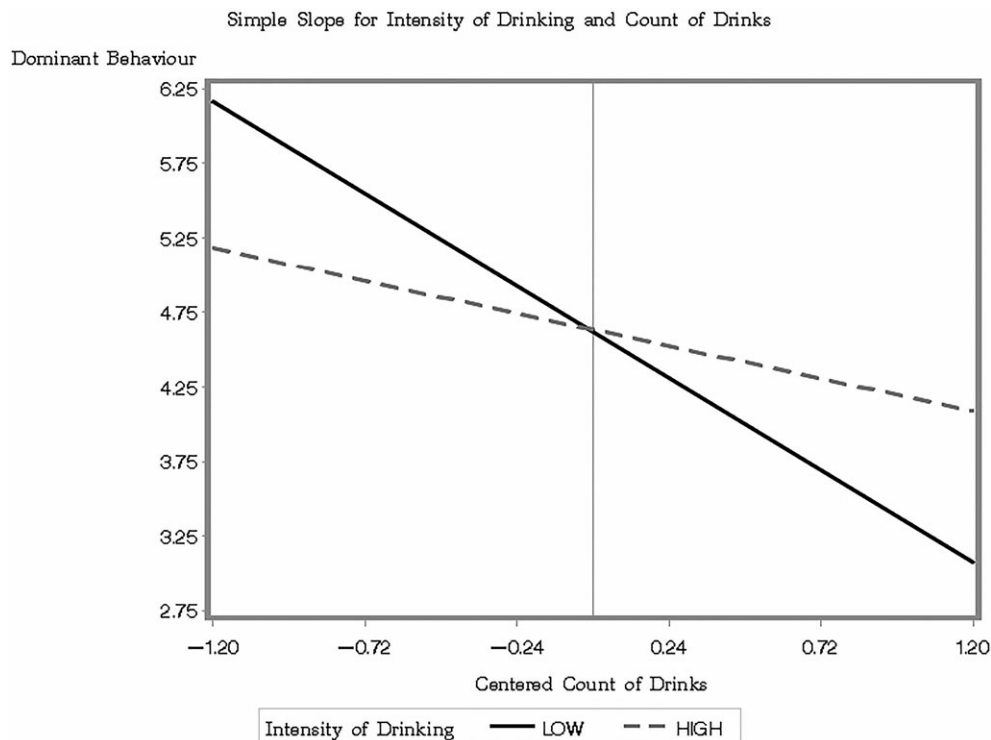
affect. Persons who had more drinks than usual reported more positive affect but not less negative affect.

*Person Level (Between-Person).* There were no significant findings for frequency of social drinking on either positive affect or negative affect. Neither was there a significant association between intensity of social drinking and positive affect or negative affect.

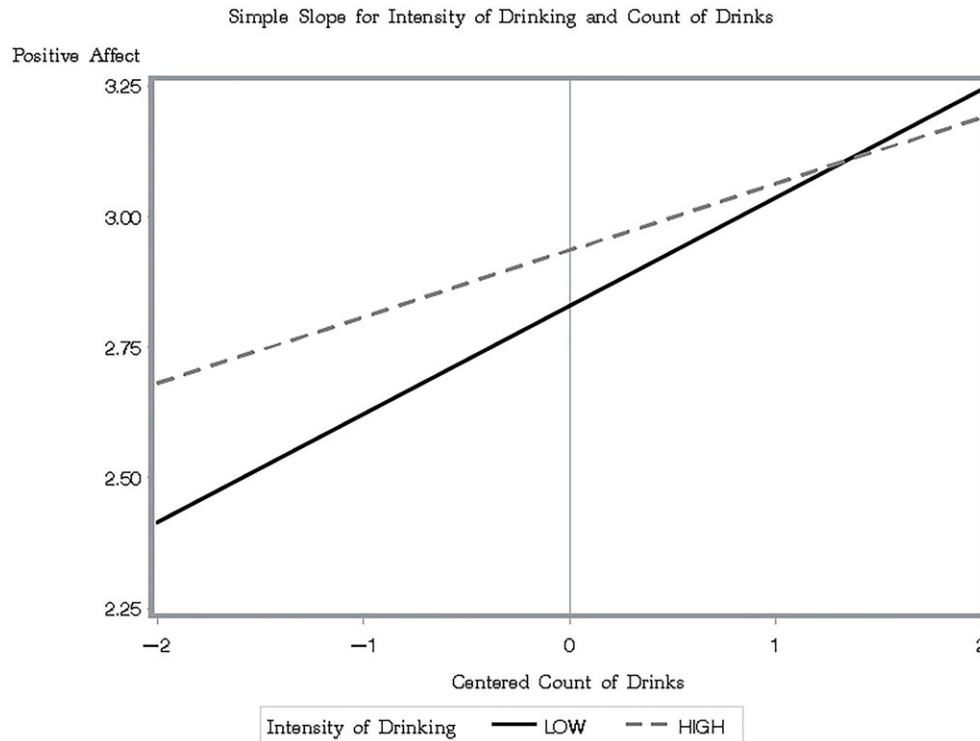
*Cross-Level Interactions Effects of Person-Level Variables on Event-Level Associations.* The frequency of social drinking did not significantly moderate the event-level association between drinking episode and positive affect or negative affect. Intensity of social drinking did significantly moderate the event-level association between number of drinks and positive affect ( $b = -0.02$ ;  $r_{\text{effect size}} = 0.028$ ) but did not significantly moderate the association between number of drinks and negative affect. Relative to more intense social drinkers, less intense social drinkers reported greater increase in positive affect when having more drinks than usual (slope for less intense social drinkers:  $b = 0.226$ ,  $t(12E3) = 7.25$ ,  $p < 0.001$ ; slope for more intense social drinkers,  $b = 0.137$ ,  $t(12E3) = 7.99$ ,  $p < 0.001$ ; see Fig. 2).

#### *Associations Between Drinking and Interpersonal Perception*

*Event Level (Within-Person).* The associations of perceived agreeableness with drinking ( $b = 0.26$ ;  $r_{\text{effect size}} = 0.028$ ) and perceived dominance with drinking ( $b = 0.26$ ;  $r_{\text{effect size}} = 0.028$ ) were not significant.



**Fig. 1.** Dominant behavior in response to amount of drinking for high versus low intensity of social drinking.



**Fig. 2.** Positive affect in response to amount of drinking for high versus low intensity of social drinking.

size = 0.026) and number of drinks ( $b = 0.07$ ;  $r_{\text{effect size}} = 0.035$ ) were significant. When persons had drunk, they reported perceiving others as more agreeable. Persons who had more drinks than usual also perceived others as more agreeable.

There were no significant associations of perceived dominance with drinking or number of drinks.

*Person Level (Between-Person).* Frequency of social drinking was significantly associated with perception of agreeableness ( $b = -0.02$ ;  $r_{\text{effect size}} = 0.137$ ) but not with perception of dominance. Frequent social drinkers reported perceiving others as less agreeable. There were no significant findings for intensity of social drinking on perceived agreeableness or perceived dominance.

*Cross-Level Interactions or Moderation Effects of Person-Level Variables on Event-Level Associations.* The intensity of social drinking did not significantly moderate the event-level associations between number of drinks and perceived agreeableness or perceived dominance and did not moderate the association between drinking episode and perceived agreeableness. Frequency of social drinking did moderate the event-level association between drinking episode and perceived dominance ( $b = 0.02$ ;  $r_{\text{effect size}} = 0.024$ ). Less frequent social drinkers perceived others as behaving less dominantly when reporting more drinks than average,  $b = -0.311$ ,  $t(8,824) = -1.82$ ,  $p = 0.069$ ; more frequent social drinkers perception of others' dominant behavior did not vary as a

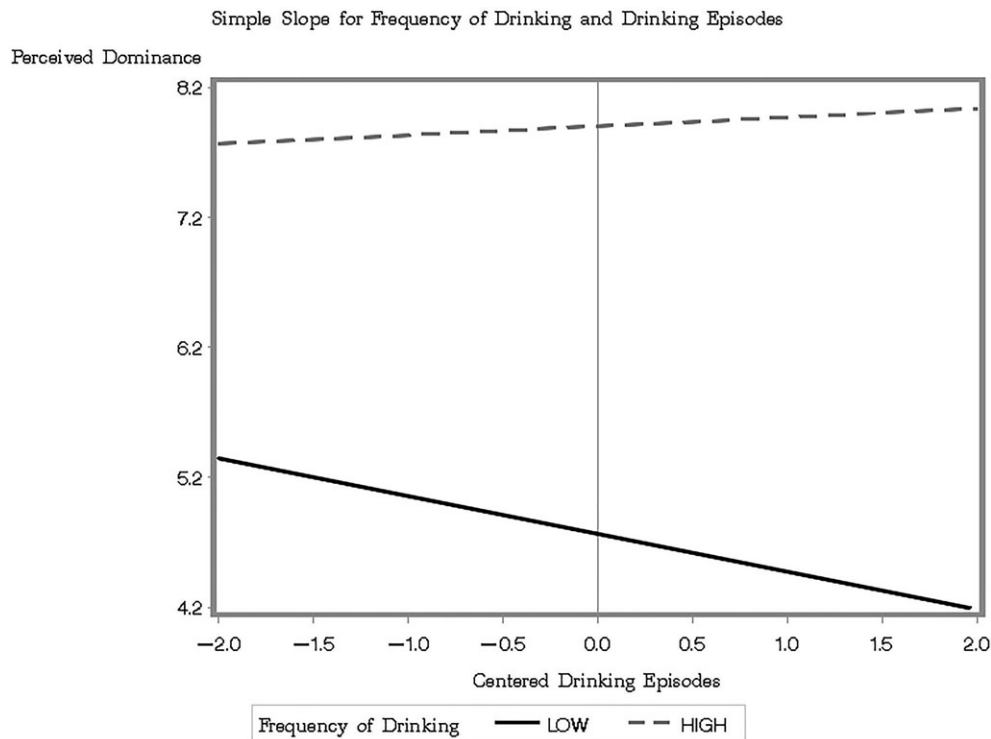
function of number of consumed drinks,  $b = 0.036$ ,  $t(8,824) = 0.36$ ,  $p = 0.722$ ; see Fig. 3.

### Exploratory Analyses

*Effect of Sex.* Sex was entered as moderator of the event-level and between-person alcohol predictors. With 1 exception, the participant's sex did not moderate the associations of event-level and between-person alcohol variables with interpersonal behavior, affect, or perception (nonsignificant results not shown). Sex moderated the association between frequency of social drinking and agreeable behavior,  $b = 0.30$ ;  $F(1, 215) = 5.25$ ,  $p = 0.023$ ;  $r_{\text{effect size}} = 0.154$ . Frequency of social drinking was more strongly related to agreeable behavior among women than men. Female frequent drinkers reported more agreeable behavior than male frequent drinkers during social interactions.

*Effect of Age.* Age was entered as a moderator of the event-level and between-person alcohol predictors. With 1 exception, the participant's age did not moderate the associations of event-level and between-person alcohol variables with interpersonal behavior, affect, or perception (nonsignificant results not shown). Frequency of social drinking was more strongly related to perception of dominance among older than younger participants,  $b = -0.01$ ;  $F(1, 213) = 4.12$ ,  $p = 0.043$ ;  $r_{\text{effect size}} = 0.138$ . Older frequent drinkers reported perceiving others as less dominant





**Fig. 3.** Perceived dominance in response to drinking episodes for high versus low frequency of social drinking.

compared to their younger counterparts during social interactions.

## DISCUSSION

Results of the present study suggest that drinking during or within 3 hours prior to a social interaction resulted in participants reporting more quarrelsome and agreeable behaviors, fewer dominant and submissive behaviors, better mood, and perception of the interaction partner as more agreeable. When frequent or intense social drinkers drank, they described behaving more dominantly, having worse mood, and perceiving their interaction partner as more dominant.

The alcohol-induced increase in agreeable behavior and positive affect and agreeable perception of others was consistent with our expectations and in line with findings of Aarseth and colleagues (2008) who used a similar ECR design for studying real-life social interactions. Solely interpreting these findings would indicate that alcohol has a positive effect on interpersonal behavior, affect, and perception. However, we also found increases in quarrelsome behavior as well as decreases in dominant and submissive behaviors, which is not only inconsistent with our hypotheses but also contradictory to Aarseth and colleagues' (2008) findings. We assessed interpersonal behaviors and perceptions based on the interpersonal circumplex model by Leary (1957) which characterizes interpersonal behavior using 2 major axes, namely quarrelsome versus agreeable and dominant versus submissive. Therefore, our findings are contradictory

in that we found increases (or decreases, respectively) in behaviors that are on opposite sides of a dimension. Based on these results, one could conclude that there seems to be event-level or intraindividual variability in how alcohol affects interpersonal behavior.

Steele and Josephs (1990) viewed such intraindividual variability in reactivity to alcohol as a consequence of alcohol-induced myopia and situational cues. More specifically, alcohol myopia results in more impulsive and extreme behavioral responses, because the person is less capable of evaluating possible consequences of actions. Certain situations can serve as inhibition factors that prevent the person from acting upon salient spontaneous impulses, while other situations may preempt inhibition and consequently foster drunken excessive behaviors (Steele and Josephs, 1990). In our sample, external factors such as differences in environment (e.g., home, restaurant), in relation to the interaction partner (e.g., romantic partner, acquaintance) or in whether the interaction partner had also drunk could have played a role in the effect of alcohol on participants' interpersonal behaviors, affect, and perceptions. Thus, while a participant might have behaved more agreeably toward a close friend when drinking, this participant might have been inclined to act more quarrelsomely when interacting with an acquaintance. Therefore, specific situational cues present in each interpersonal situation might account for the intraindividual variability in reactivity to alcohol in our sample.

Another explanation of these findings follows from the subjective response concept of Earleywine and Martin (1993)

and Earleywine (1994). They suggest that individuals can have varying subjective effects depending on rising or falling blood alcohol levels. Laboratory-based studies have provided evidence for this notion and reported that when participants started drinking and blood alcohol levels were rising, alcohol had stimulatory and hedonic subjective effects, but once blood alcohol levels were descending, participants reported generally sedative and aversive effects (Erblich et al., 2003; Ray et al., 2009; Roche et al., 2014). As we did not assess blood alcohol levels, we were not able to take them into account. We do not know when their alcohol consumption started or ended within the 3-hour interval preceding the end of the interaction event. Therefore, our contradictory effects could be a consequence of some participants reporting their interpersonal behaviors during a time when their blood alcohol levels were on the rise, while other participants might have reported their behaviors while being on the descending limb of intoxication. Nonetheless, as we statistically controlled for interaction length, this variable likely did not have bias the presumed effects of social drinking on interpersonal behavior, affect, and perceptions. Social drinking frequency and intensity seemed to have a moderating effect on the associations of event-level drinking variables with perceptions, affect, and behavior. Frequent social drinkers (i.e., with more social drinking episodes than others) perceived others as more dominant when they drank compared to less frequent social drinkers and when intense social drinkers (i.e., with a higher average number of drinks during a social interaction than others) drank, they reported behaving more dominantly and experiencing less pleasant affect than less intense social drinkers. Thus, it seems as if people who consume more alcohol or who consume on more occasions than others experience effects of drinking as less pleasant than their more moderate counterparts. When these individuals drink, their behavior may escalate into aggression as an attempt to take control of the situation in response to perceiving increased dominance in the interaction partner's behavior. These findings are not in line with previous research that suggested that intense and frequent drinkers have a greater stimulating and hedonic subjective response to alcohol intoxication and perceive less sedative and aversive effects than lighter or less frequent drinkers (King et al., 2011; Quinn and Fromme, 2011). Examination of external factors or characteristics of the social interactions may clarify when frequent and intense social drinkers perceived the effects of drinking as less pleasant.

### *Limitations*

We assessed alcohol use by asking about the amount of drinks consumed during and up to 3 hours prior to the interactions. Information on type and concentration of ethanol, and on start time and length of drinking episodes were not assessed. Taking into account the subjective response concept, it seems important to differentiate between the ascending and the descending limb of intoxication when evaluating

alcohol's effects. Our assessment approach included a long time span in which participants could have consumed alcohol which did not permit us to gauge on which limb the participant was when reporting interpersonal behaviors. Future ecological momentary assessment studies should try to assess alcohol use more precisely, for instance, by asking when the participant started to drink during the social interaction. Participants' smartphones could also be equipped with smartphone breathalyzers that are able to track the user's alcohol levels, permitting the determination of whether the participant reported the social interaction during the ascending and descending limb of intoxication (see, e.g., <http://alcoholoot.com/>).

Contextual factors were mentioned as possibly influencing our results. For example, it could be that an interaction in which both parties are under the influence of alcohol is perceived differently and triggers different interpersonal behaviors than if 1 party interacts while sober. Therefore, it might be useful to also assess the interaction partner's drinking behavior, or at least to ask participants to indicate whether their interaction partner has also been drinking.

We asked participants to indicate how many alcoholic drinks they had consumed during a social interaction. The reported interactions that involved a very high number of alcoholic drinks (i.e., more than 10 drinks) amounted to 2.5% out of all interactions that included alcohol. We cannot be certain whether this figure adequately represents the frequency of extremely intense social drinking in the sample or not; after more drinks, participants may have been less likely to report social interactions because of being too intoxicated.

## CONCLUSION

In the present study, there were intraindividual variability effects of alcohol consumption on interpersonal behaviors, affect, and perceptions. Individuals who drank or drank more than usual 3 hours prior to or during a social interaction reported more quarrelsome and agreeable behaviors, less dominant and submissive behaviors, better mood, and a more agreeable perception of the interaction partner. These findings were moderated by interindividual frequency and intensity of social drinking. When they drank, frequent social drinkers perceived others as more dominant and when intense social drinkers consumed larger amounts of alcohol, they acted more dominantly and concomitantly felt badly.

Our finding of intraindividual variability in behavior when individuals consume alcohol in daily life expands on prior research (e.g. aan het Rot et al., 2008; Roche et al., 2014), which mainly relied on interindividual differences and laboratory-based settings. Further, our findings suggest differential susceptibility to alcohol among frequent and nonfrequent social drinkers, which is manifested in differences in interpersonal experiences in naturally occurring social interactions.

Our ECR study design enabled us to assess alcohol use and interpersonal functioning in real-life social interactions

which is a strength as ECR has been shown to be a reliable method to assess real-life experiences (Moskowitz et al., 2009). As research about the effect of alcohol in real-life social interactions is limited, our study helps to gain understanding about how drinking episodes as well as drinking amount, frequency, and intensity influence real-life social behavior, perception of others, and affect. Future studies assessing the effect of alcohol in real-life social interactions need to assess intra- and interindividual effects of alcohol and take into account internal influences such as ascending and descending levels of intoxication and external influences such as intoxication of and relation to the interaction partner.

## CONFLICT OF INTEREST

The authors declare no conflicts of interest in relation to this paper.

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